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BULLETIN

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JUNE, 1911

Hepaticae of Puerto Rico

X. COLOLEJEUNEA, LEPTOCOLEA, AND APHANOLEJEUNEA

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(WITH PLATES 11 AND 12)

COLOLEJEUNEA

Although the vast majority of the Lejeuneae develop conspicuous underleaves, there are two recognized genera, *Metzgeriopsis* and *Cololejeunea*, in which underleaves are completely lacking. In fact Leitgeb* has shown that in *Cololejeunea calcarea* (Lib.) Schiffn. the postical segments cut off from the apical cell give rise to no appendages except rhizoids and that the hyaline papillae which usually grow out from these segments, even in the absence of underleaves, are here developed from the lateral segments instead. In all probability the conditions which he describes for *C. calcarea* exist in allied species. The lack of postical appendages is also characteristic of *Radula*, although the relationship between this genus and the Lejeuneae is somewhat remote.

The genus *Metzgeriopsis* contains a single species, the East Indian *M. pusilla* Goebel, and is especially noteworthy for the fact that leaves are borne on the sexual branches only. The vegetative portion of the plant consists of a flat dorsiventral thallus but one cell thick, bearing marginal multicellular hairs and branching in a pinnate manner. The genus *Cololejeunea*, as at present defined, contains about seventy-five species and bears leaves on

* Unters. über Lebermoose 2: 7. 1875.

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both vegetative and sexual axes. Goebel* has demonstrated the fact, however, that in the Lejeuneae, for example in *Lejeunea cavifolia* (Ehrh.) Lindb., the germinating spore develops into a minute and short-lived thalloid structure upon which the persistent leafy plant soon arises. He therefore looks upon *Metzgeriopsis* as a plan in which the embryonic or juvenile stage is long continued.

In his treatment of *Cololejeunea* Schiffner† divides the genus into the two subgenera *Physocolea* and *Leptocolea*, following the example of Spruce.‡ The most important differences between them are to be found in the perianths, the vegetative organs sharing many characters in common. In *Physocolea* the perianth is inflated and usually sharply five-keeled. In *Leptocolea* it is strongly compressed, the antical surface is plane or nearly so, and the postical surface bears a low rounded or two-angled keel. The two subgenera show the same relation to each other, therefore, as the genera *Crossotolejeunea* and *Prionolejeunea*, and the writer suggests that they be considered groups of generic rank. If this is done the name *Cololejeunea* may be retained for the first group, while the name *Leptocolea* may be applied to the second group in a generic sense. The first species which Spruce describes under *Physocolea* is the European *Lejeunea calcarea* Lib.; the first species which he describes under *Leptocolea* is the Peruvian *L. micrandroecia* Spruce. *L. calcarea* may therefore be considered the type of *Cololejeunea* and *L. micrandroecia* the type of *Leptocolea*.

Among the species which Spruce includes under *Physocolea* two distinct types of lobule are represented. The first is well shown by *C. calcarea* and its allies, the second by the European *Lejeunea microscopica* Tayl., a species which finds its closest relatives in tropical and antarctic America. The first type of lobule is found also, with certain modifications, throughout *Leptocolea*. The fact should be emphasized, however, that in these groups as in other genera of the Lejeuneae the lobule is an organ which often fails to develop normally and that a prolonged search is sometimes necessary before characteristic lobules can be demonstrated.

* Flora 72: 16, 17. f. 4. 1889.

† Engler & Prantl, Nat. Pflanzenfam. 13: 121. 1895.

‡ Hep. Amaz. et And. 292. 1884.

In the first type of lobule the keel is strongly arched, and it is usually possible to distinguish between a more or less inflated basal portion and an apical portion which is plane or nearly so, although rarely closely appressed to the lobe (PLATE II, FIGURE 1). The lobule is attached to the stem by an exceedingly short line, and the basal portion of the free margin is more or less involute. The apex is marked by a distinct tooth, usually but by no means always consisting of two cells in a row, and the sinus beyond this tooth is lunulate (FIGURE 5). Somewhere in connection with the apical tooth a hyaline papilla may be demonstrated. It may be at the very apex of the tooth, as in the African *Cololejeunea* (*Leptocolea*) *cuneifolia* Steph.,* but it is much more usual for it to be situated near the base of the tooth, either on the proximal side or on the surface turned toward the lobe (FIGURE 5). Not far from the apical tooth and also on the proximal side a second tooth is usually developed. This is commonly shorter and less definite than the apical tooth, but sometimes the differences between them are not strongly marked. In certain species, for example in the New Zealand *Lejeunea* (*Leptocolea*) *laevigata* Mitt.,† there is even a third tooth between the second tooth and the base of the lobule. A marked deviation in appearance from the lobules just described is to be found in the paleotropic *C. (Leptocolea) lanciloba* Steph.‡ and in some of its immediate allies. In these the lobule is plane or nearly so, and the apical tooth is represented by a broad and blunt lamina (FIGURE 13). Even here, however, the hyaline papilla is found at the apex of the lobule, and the second tooth is distinct and in its normal position. Such lobules may therefore be regarded as having been derived from the first type.

The lobule of *Lejeunea microscopica* and its allies is built up on an essentially different plan, although agreeing with the first type in having a short line of attachment and an arcuate keel. It is usually larger in comparison with the lobe, and the revolute free margin frequently involves the apex itself. The apical tooth

* Hedwigia 31: 166. pl. 10. 1892.

† Fl. Nov. Zeland. 157. 1855.

‡ Hedwigia 34: 250. 1895. See also Evans, Trans. Conn. Acad. 10: 452. pl. 59. f. 1-7. 1900.

is represented by a single projecting cell and the second, or proximal, tooth is no better developed, the two being separated from each other by a slight indentation at the bottom of which a single cell of the lobule reaches the margin (PLATE 12, FIGURES 6, 13, and 21. Unless careful dissections are made the two teeth present the appearance of a single tooth, and the apex might readily be described as simply acute. In this type of lobule the hyaline papilla is situated in the lunulate sinus, slightly displaced to the inner or antical surface. It may therefore be described as distal with respect to the apical tooth. The species showing this type of lobule are among the most delicate of the *Lejeuneae*, and it seems advisable to segregate them from *Cololejeunea* as a distinct genus, to which the name *Aphanolejeunea* may be applied.

What may be a third type of lobule is found in the Javan *Cololejeunea ciliatilobula* Schiffn.* In this species the free margin of the lobule bears a number of hairlike teeth between the apical tooth and the base. Whether this peculiarity is sufficiently distinctive to serve as the basis for further segregation is uncertain; it is possible that it represents nothing more than an extreme manifestation of the tendency noted in *Lejeunea laevigata* to develop accessory proximal teeth. Unfortunately *C. ciliatilobula* is known to the writer from descriptions and figures only.

In its restricted sense the genus *Cololejeunea* contains about twenty known species. It is quite impossible, however, to give more than an approximate estimate because so many have been described from sterile or otherwise incomplete material. It is also very probable that many new species may be expected, both here and in the genera *Leptocolea* and *Aphanolejeunea*. Although the genus is largely tropical its range extends well into Europe and temperate North America. The northern species grow on rocks and on bark. The tropical species occur in similar localities and also on living leaves. Certain species are much less particular about their substratum than others, the North American *C. Biddlecomiae* (Aust.) Evans, for example, growing on both rocks and trees, while the closely allied *C. calcarea* seems to be confined to rocks. The plants are easily overlooked on account of their

* Conspect. Hepat. Archip. Indici 242. 1898. (= *Lejeunea ciliatilobula* Schiffn. Nova Acta Acad. Caes. Leop.-Carol. 60: 239. pl. 10. f. 11-13. 1893.)

minute size and also because they frequently occur in admixture with other bryophytes.

The various species of *Cololejeunea* have slender and fragile stems which branch irregularly according to the typical *Lejeunea* type. They cling closely to the substratum by means of rhizoids, which are borne in clusters, one at the base of each leaf. In some cases the leaves are loosely imbricated but it is much more usual for them to be separated. The lobes are attached to the axis along an exceedingly short line which is almost transverse. The same condition is found in *Leptocolea*, *Aphanolejeunea*, and *Diplasiolejeunea* and is in marked contrast to the method of attachment found in most of the other genera of the Lejeuneae, where the line is long and oblique. The lobes exhibit considerable diversity, not only in form but in the finer details of structure. They are more or less convex and spread widely from the axis, which is sometimes partly covered by the arching bases. In outline the lobes vary from broadly ovate to lanceolate, the apex showing all gradations from rounded to acuminate. The margin is usually crenulate or denticulate from projecting cells but is occasionally entire.

The cells of the lobe are sometimes plane and sometimes convex or conical, and the antical surface of the lobe is smooth or rough in consequence. The roughness, however, rarely affects the portion of the lobe which helps enclose the basal water sac but is almost always restricted to a narrow or broad band involving the apical region and perhaps the antical portion as well. The walls of the cells are usually thin and delicate throughout, but in some cases minute trigones are developed and the wall at the tip of a conical cell may also be slightly thickened. Hyaline marginal cells and ocelli, which are characteristic of certain species of *Leptocolea*, are apparently not found in *Cololejeunea*.

The peculiarities of the lobule have already been noted, but another foliar structure, the stylus, should be briefly alluded to. This is situated at the base of the lobule and usually consists of a hyaline papilla only, similar to what is found in the other genera of the Lejeuneae. In many cases, however, the hyaline papilla cuts off a single cell at the base, thus making the stylus two-celled, while in a few species a whole series of cells is cut off and the stylus

may develop into a slender filiform process from two to ten cells long and sometimes two cells wide throughout more or less of its extent. This is the case, for example, in both *C. calcarea* and *C. Biddlecomiae*. The stylus apparently reaches its highest development in *Lejeunea* (*Colo-Lejeunea*) *pseudostipulata* Schiffn.,* of New Guinea, where it forms a broad leaflike appendage, comparable with the stylus found in certain species of *Frullania*.

The inflorescence is autoicous in the majority of the species, but is dioicous in a few. The archegonium is borne on a more or less elongated branch, and the female flower is invariably subtended by one or two innovations. The bracts spread less widely than the leaves, and their lobes are usually smaller and narrower. The lobules are plane and differ more or less from the lobules of the leaves in their apical and marginal teeth. The perianth is typically obovoid and abruptly contracted into a short beak. The five keels are sometimes restricted to the apical region and sometimes extend to below the middle. The cells are similar to the leaf cells but often project in a more conspicuous way especially along the keels. In the male inflorescence the lobules of the bracts are usually larger than in the leaves and are sometimes as large as the lobes. The antheridia are borne singly or in pairs, both conditions being occasionally found in the same species.

The sporophyte is of the type seen in the majority of the *Lejeuneae*. The small spherical capsule is borne on a short stalk, which has at its base a slightly developed foot. The valves of the capsule are only one cell thick and the cell walls are thickened irregularly. Even the truncate elaters lack the spiral thickenings which are found in most genera, and show irregular thickenings only. The spores are green and variable in form, some being much longer than others. Their walls are slightly thickened and minutely verruculose.

No species of *Cololejeunea* in its restricted sense have been recorded from Puerto Rico. Two species, however, occur in the collections studied by the writer.

***Cololejeunea myriocarpa* (Nees & Mont.)**

Lejeunea myriocarpa Nees & Mont. in Ramon de la Sagra, Hist. Fis. Pol. y Natur. Cuba 9: 473. 1845.

*Leberm. der "Gazelle" Exped. 33. pl. 7. f. 9-11. 1890.

- Lejeunea epiphyta* Gottsche in G. L. & N. Syn. Hep. 391. 1845.
Lejeunea Wrightii Gottsche in Wright, Hep. Cubenses (without description). Stephani, Bot. Gaz. **17**: 172. 1892 (*nomen nudum*).
Lejeunea (*Colo-Lejeunea*) *myriocarpa* Steph. Hedwigia **29**: 89. 1890.
Lejeunea (*Cololejeunea*) *heteromorpha* Spruce, Jour. Linn. Soc. Bot. **30**: 348. pl. 24. f. 5-9. 1894.

Bright green or yellowish, growing in depressed mats: stems appressed to the substratum, irregularly and often copiously branched, the branches widely spreading, similar to the stem; rhizoids variable in abundance, occurring singly or in small clusters: leaves distant to subimbricated, the lobe obliquely to widely spreading, ovate or semiovate with a rounded or very obtuse apex, averaging about 0.35×0.2 mm. (but varying much in size), margin crenulate from projecting cells; lobule usually represented by an indistinct fold, connected with the lobe by a rounded keel, crenulate along the margin except near the base and with an indistinct apical tooth and sinus, hyaline papilla marginal but slightly displaced to inner surface; leaf cells convex, thin-walled throughout, averaging about 14μ along the margin, 18μ in the middle of the lobe, and 22μ at the base: inflorescence autoicous: ♀ inflorescence borne on a more or less elongated branch, innovating on one side, more rarely on both, the innovations often floriferous; bracts similar to the leaves but a little larger, erect-spreading, the lobe 0.45×0.25 mm., the lobule a little shorter and narrower with a rounded apex, margin crenulate as in the leaves; perianth obovoid, 0.45 mm. long, 0.3 mm. wide, sharply five-keeled to about the middle, the keels roughened from projecting cells, beak short and broad, often almost obsolete, basal stipe (formed after fertilization) sometimes very conspicuous: ♂ inflorescence very variable in length and in the number and form of the bracts, the latter distant or subimbricated, erect or erect-spreading, in more typical cases subequally bilobed with a strongly arched keel and rounded divisions, the lobule a little shorter than the lobe; antheridia borne singly or in pairs: capsule about 0.2 mm. in diameter; spores greenish, minutely verruculose, about 14μ in short diameter; elaters about 3μ in diameter.

On bark of trees. Near Cayey, *Evans* (101). This species was originally described from specimens collected by Ramon de la Sagra at Havana, Cuba, and was afterwards found by Wright on the same island and distributed in his Hepaticae Cubenses. It is known also from St. John (Danish West Indies), *Breutel*

(type of *L. epiphyta*); from St. Vincent, *Elliott* (type of *L. heteromorpha*); from Jamaica, *Evans*; and from Mexico, *Karsten*. The Jamaican specimens grew on rocks but the others were apparently all found on trees. The type specimen of *L. myriocarpa* is preserved in the Montagne herbarium at the Jardin des Plantes, Paris, and that of *L. heteromorpha* in the herbarium of the British Museum, where the Mexican specimens of *L. myriocarpa* are also to be found. The writer has examined these three specimens and finds that they evidently represent the same species and that they agree closely with the plants from Puerto Rico and Jamaica and also with those in Wright's distribution. The specimen of *L. epiphyta* in the Lindenberg herbarium at Vienna was studied by Stephani and referred by him to *L. myriocarpa*. No other stations for the species can be safely quoted at the present time.

It is very difficult to assign definite characters to *Cololejeunea myriocarpa* because the species is not only extremely variable but often presents the appearance of being incompletely or abnormally developed. This is especially true of the lobule, which usually yields characters of great importance in the Lejeuneae. In *C. myriocarpa* there is often nothing more than a mere fold along the postical side of the lobe to represent the lobule, and the keel is sometimes so nearly obliterated that both lobe and lobule are practically in one plane. It is only in the rarest instances that a lobule is found which represents a structure more typical of the genus. In these cases the keel is sharper and a distinct apical tooth, consisting of two superimposed cells, is developed. Even here, however, the proximal tooth is scarcely apparent. The variability which is so manifest in the foliage leaves affects also the perigonal and perichaetial bracts and, to a less extent, the perianth. The cylindrical stipe which develops at the base of this organ after fertilization is largely responsible for the variation in form which it shows. In extreme cases the stipe may equal or exceed the perianth itself and carry it far beyond the bracts, and this condition is connected by intergradations with perianths in which no stipe whatever is formed.

The close relationship which exists between *C. myriocarpa* and *C. minutissima* (Sm.) Schiffn. was fully recognized by Montagne. The two species share so many characters in common that it is

almost impossible to draw sharp distinctions between them, and they rival each other in variability. According to Montagne there are three differences which ought to be especially emphasized. In *C. myriocarpa* he states that the lobule is distinctly shorter than the lobe, that the perichaetial bracts are shorter than the perianth and entire at the apex, and that the mature capsule is oval. In *C. minutissima*, on the other hand, he states that the lobule is about as long as the lobe, that the bracts nearly equal the perianth in length and are distinctly indented at the apex, and that the capsule is spherical. Of course the third difference is based on a misconception. Throughout the Lejeuneae the capsule is spherical, and the oval appearance which it shows after dehiscence (PLATE 12, FIGURE 1) is simply due to the fact that the valves do not quite resume their original position. The other differences given by Montagne are fairly constant, but the distinction between the bracts might be brought out a little more clearly by saying that the lobule in *C. minutissima* is usually definite, the keel being sharp, whereas in *C. myriocarpa* it is usually poorly defined, the keel being rounded or obsolete. It may also be added that the leaf lobes in *C. minutissima* are nearly rotund, while in *C. myriocarpa* they are more elongated. There are still other differences in the gemmae, which will be discussed later on. Whether the true *C. minutissima* occurs in the West Indies is uncertain. It is frequent in southern and western Europe and is also found, in North America, in the Gulf States and along the Atlantic as far north as South Carolina. It has likewise been collected in Bermuda. Its discovery in the Bahamas or in Cuba would therefore not be surprising.

COLOLEJEUNEA DIAPHANA Evans

Cololejeunea diaphana Evans, Bull. Torrey Club 32: 184. pl. 5. f. 9-14. 1905.

On leaves of a tree. Three miles east of Santurce, Heller (464). The type specimens grew on bark in southern Florida and were collected by Small and Carter. No other stations for the species are known.

The specimens from Puerto Rico are very scanty and are referred to *C. diaphana* with considerable hesitation. They are

somewhat more robust than the Florida plants, the leaf lobes measuring 0.45 mm. in length and 0.2 mm. in width. The lobules unfortunately are all in an exceedingly rudimentary condition, so that their typical structure cannot be ascertained. The leaf cells are just a trifle larger than in the type, averaging $28 \times 16\mu$ in the middle of the lobe and 16μ along the margin. In other respects the vegetative organs agree closely. The perianth of the Puerto Rico plant is five-keeled in the upper part, indicating pretty clearly that it belongs in *Cololejeunea*. The only perianth present in the type material is very immature and is more or less compressed, but it is probable that it would present a different appearance when completely developed and would perhaps agree closely with the five-keeled perianth of the Puerto Rico plant. The gemmae of the two specimens are identical in every way. The relationships of *C. diaphana* are discussed in connection with the original description.

LEPTOCOLEA

The genus *Leptocolea* is considerably larger than *Cololejeunea* and includes about fifty known species. Although almost exclusively tropical an occasional species is found in temperate regions. Most of the representatives of the genus are epiphyllous in habit, a few grow on bark, and two or three have been described as creeping over other Hepaticae. Apparently none of the species grow directly on rocks. Although nearly every species is restricted to a particular substratum, this is not always the case, *L. cardiocarpa*, for example, growing on either leaves or bark. The plants rarely form pure mats but are usually badly mixed with other bryophytes.

The species of *Leptocolea* tend to be larger than those of *Cololejeunea*, and firmer in texture, but there are many exceptions to this rule. Most of the statements which have been made about the leaves in *Cololejeunea* will also apply to *Leptocolea*. It should be added, however, that the lobes are much more likely to be rounded at the apex and that the lobules are relatively smaller (PLATE II, FIGURES 1 and 9). The leaf cells, moreover, exhibit a greater variety. In some cases they equal the cells of *Cololejeunea* in delicacy, but in other cases their walls are thickened, either uniformly or locally. Sometimes the local thickenings are

in the form of trigones only, but intermediate thickenings also are present in certain species (FIGURE 11). The local thickenings may likewise form hyaline warts or spinules on the free outer walls of the cells, usually one in the middle of each cell. In certain species the leaf cells show a higher degree of differentiation than in *Cololejeunea*. Ocelli, for example, may be present or the cells along the margin may become empty and hyaline (FIGURE 12). The stylus, so far as known, consists either of a hyaline papilla or of a slender filament variable in length.

An autoicous inflorescence seems to be the usual type in *Leptocolea*, but in rare instances it may be dioicous, paroicous, or even synoicous. The branch bearing the female inflorescence varies greatly in length but is often much abbreviated (FIGURE 1). It always bears one or two innovations and these may sometimes be floriferous (PLATE 12, FIGURE 1). The bracts show the same characters as in *Cololejeunea*. The perianth varies considerably in different species, although always more or less compressed (PLATE 11, FIGURES 7 and 16). In some cases a very low antical keel and a low two-angled postical keel may be demonstrated, but the antical surface is often plane and the postical keel rounded. The apex of the perianth is broader than the base and varies from rounded to truncate or obcordate. In the last case the short beak appears at the bottom of the apical depression. In the male inflorescence the bracts are sometimes indistinguishable from the leaves (FIGURE 2), but they are often much smaller and have relatively larger lobules (FIGURE 3). Certain species, in fact, show a wide range of variation in the bracts. The sporophyte is essentially like that of *Cololejeunea*. *Leptocolea* may be briefly characterized as follows:

***Leptocolea* (Spruce) gen. nov.**

Lejeunea, subgenus *Colo-Lejeunea*, section *Leptocolea* Spruce, Hep. Amaz. et And. 292. 1884.

Cololejeunea, subgenus *Leptocolea* Schiffn. in Engler & Prantl, Nat. Pflanzenfam. 1³: 122. 1895.

Plants varying from delicate to robust, pale green, often becoming whitish, yellowish, or brownish with age: stems prostrate, irregularly branched: leaves distant to imbricated, the lobe mostly

plane or nearly so, widely spreading and sometimes arching across the axis, usually ovate to oblong, the apex mostly rounded or bluntly pointed and the margin entire or minutely toothed from projecting cells; lobule (as in *Cololejeunea*) normally inflated at the base and plane or nearly so in outer portion, keel arched, apex with a distinct tooth, hyaline papilla in the vicinity of the apex, variable in position but proximal rather than distal with respect to the apical tooth, free margin bearing a second tooth proximal to the apex, sinus lunulate; underleaves wanting; inflorescence usually autocious: ♀ inflorescence innovating on one or both sides; bracts similar to the leaves but often smaller and with a plane lobule; perianth broadening out from a narrow base, distinctly compressed.

Type species, ***Leptocolea micrandroecia*** (Spruce) comb. nov. *Lejeunea* (*Colo-Lejeunea*) *micrandroecia* Spruce, Hep. Amaz. et And. 298. 1884.

A single species of *Leptocolea*, ***L. marginata*** (Lehm. & Lindenb.) comb. nov.,* was reported from Puerto Rico by Hampe and Gottsche.† In the Hampe herbarium, now preserved in the British Museum, there is a small packet labeled "*L. marginata*, Porto Rico," with a pencil mark drawn through the specific name. This apparently represents the material upon which the record was based. The packet contains a few plants only, but these show distinct underleaves and belong to the genus *Diplasiolejeunea*, probably to *D. pellucida* (Meissn.) Schiffn., a species with which *L. marginata* was sometimes confused by the older authors. The collections examined by the writer contain four species of *Leptocolea*, one of which seems to be undescribed. The peculiarities of *L. marginata* will be discussed in connection with this new species.

***Leptocolea scabriflora* (Gottsche)**

Lejeunea scabriflora Gottsche, Abh. Bremen Naturw. Ver. 7: 362. 1882 (*nomen nudum*).

Lejeunea erigens Spruce, Hep. Amaz. et And. 298. 1884 (as synonym).

* *Jungermannia marginata* Lehm. & Lindenb. in Lehmann, Pug. Plant: 5: 11. 1832. *Lejeunea marginata* Lehm. & Lindenb. in G. L. & N. Syn. Hep. 393. 1845. *Lejeunea* (*Cololejeunea*) *marginata* Steph. Hedwigia 27: 287. 1888. *Cololejeunea marginata* Schiffn. Conspect. Hepat. Archip. Indici 245. 1898.

† Linnaea 25: 356. 1852.

Cololejeunea erigens Spruce, Hep. Spruceanae. 1892 (name only).

Evans, Trans. Conn. Acad. 10: 450. 1900.

Cololejeunea scabriflora Gottsche in Stephani, Hedwigia 34: 251. 1895.

Pale green or bright green, growing in depressed mats: stems clinging closely to the substratum, 0.07 mm. in diameter, simple to copiously and irregularly branched, the branches widely spreading, usually with somewhat smaller leaves than the stem: leaves distant to loosely imbricated, the lobe widely spreading, somewhat falcate, oblong-ovate to oblong-obovate, very variable in size, reaching a maximum of perhaps 0.7×0.45 mm., broad and rounded at the apex, antical margin rounded near the base, arching partially or wholly across the axis, postical margin straight or slightly curved, continuous with the arched keel or showing a shallow indentation at the junction, whole margin (except at the very base) minutely and irregularly denticulate from projecting cells; lobule ovate, 0.25 mm. long and 0.15 mm. wide (on large leaves), inflated in basal region or throughout the greater part of its extent, plane in outer portion, apical tooth usually consisting of two cells in a row, the lower cell bearing the hyaline papilla on its inner surface, proximal tooth shorter and usually consisting of a single blunt or acute projecting cell, separated from the apical tooth by one cell only, sinus shallow, about three cells long; cells of lobe averaging 13μ at the margin, $23 \times 17\mu$ in the middle and about $35 \times 23\mu$ at the base, thin-walled or with minute trigones and occasional intermediate thickenings, cells in apical region and along margin (in a zone from one to six cells wide) sharply conical and slightly thickened at the apex, remaining cells plane or nearly so: inflorescence autoicous (with occasional male individuals): ♀ inflorescence sometimes borne on a leading branch but usually on a more or less abbreviated branch, in extreme cases bearing no leaves except the bracts, innovating on one side, the innovation sometimes bearing a second female flower, sometimes simple and sterile, sometimes simple and tipped with a male inflorescence; bracts obliquely spreading, complicate, the lobe oblong, about 0.4 mm. long and 0.2 mm. wide, rounded to subacute, irregularly crenulate from projecting cells, lobule oblong, about 0.35×0.1 mm., irregularly toothed or lobed at the apex, margin otherwise as in lobe; perianth long-exserted, narrowly obovate, 0.85 mm. long, 0.35 mm. wide, truncate or subretuse at the apex, the upper angles rounded and the beak short, antical surface plane or nearly so, postical keel low and broad, rounded or two-angled in the upper part, the sharp lateral keels minutely denticulate from projecting cells, surface otherwise smooth or nearly so: ♂ inflores-

cence very variable, terminal on a more or less elongated branch and often proliferating at the apex; bracts mostly in from two to six pairs, distant to contiguous, monandrous, sometimes essentially like the leaves but usually smaller, suberect, more equally bifid, the lobe relatively narrower and the lobule more uniformly inflated and frequently with obsolete teeth on the free margin: capsule about 0.2 mm. in diameter; spores greenish, minutely verruculose, about 14μ in short diameter; elaters about 9μ in diameter. (PLATE II, FIGURES 1-8.)

On leaves of shrubs and trees. Near Cayey, *Evans* (70, 71, and 72, in part). Mayagüez, *E. G. Britton & D. W. Marble* (536, in part). Widely distributed in the American tropics and especially abundant in Brazil, where it has been found by numerous collectors. The following localities may also be noted: Trinidad, *Crueger* (the type station); Cuba, *Wright*; Jamaica, *Underwood, Evans*; Andes, *Spruce*.

Spruce referred the present species with some question to *Lejeunea obliqua* Nees & Mont.* and described it fully under this name, quoting his manuscript species, *L. erigens*, as a synonym. A few years later he cast doubt on his earlier determination by distributing specimens under the name *L. erigens*, but apparently he never published this name formally. *L. obliqua* was described from sterile specimens collected by *Leprieur* in French Guiana. The authors of the Synopsis Hepaticarum considered it a mere synonym of *Lejeunea cuneata* Lehm. & Lindenb.,† which was described from Mauritian plants, also sterile, and *Montagne* accepted their decision in his Sylloge, published in 1856. Unfortunately no specimens of *L. obliqua* can be discovered in the *Montagne* herbarium at Paris, and there is therefore no way of deciding whether the French Guiana plant is identical with *L. scabriflora* or not. The writer has also been unable to secure specimens of *L. cuneata* for examination, but a drawing made from the original material and kindly communicated by *Stephani* shows conclusively that the plant from Mauritius is widely distinct from *L. scabriflora*. The leaves in *L. cuneata*, for example, are much broader and might accurately be described as orbicular-ovate.

* In *Montagne*, Ann. Sci. Nat. Bot. II. 19: 264. 1843.

† In G. L. & N. Syn. Hep. 394. 1845. (= *Jungermannia cuneata* Lehm. & Lindenb. in *Lehmann*, Pug. Plant. 4: 56. 1832.)

It is perfectly safe to say, therefore, that *Leptocolea scabriflora* is not synonymous with *Lejeunea cuneata*, even if its relationship to *Lejeunea obliqua* must be left unsettled.

There are apparently no species very nearly related to *L. scabriflora* in the American tropics, but in Asia, Africa, and the islands of the Pacific several close allies have been discovered. Only two of these will be considered here, **Leptocolea Goebelii** (Gottsche) comb. nov.,* from Java, and **Leptocolea ceatocarpa** (Ångstr.) comb. nov.,† from the Hawaiian Islands. *L. Goebelii* is a little more robust than *L. scabriflora*, the perianth is distinctly obcordate, and the perigonal bracts are diandrous. It is further distinguished by its more coarsely denticulate leaves, the teeth being sharp and irregularly scattered along the greater part of the margin. In *L. ceatocarpa* the lobes of the leaves are narrower than in *L. scabriflora* but the character of the margin is much the same. The Hawaiian species is distinguished further by its diandrous bracts and by its obcordate perianth, although the emargination is less marked than in *L. Goebelii*. In all three species the lobules are essentially the same.

Leptocolea planifolia sp. nov.

Pale green, growing scattered or in depressed mats: stems 0.08 mm. in diameter, closely appressed to the substratum, sparingly and irregularly pinnate, the branches widely spreading, not microphyllous: leaves loosely imbricated, the lobe widely spreading, slightly falcate, ovate to subobovate, 0.75 mm. long and 0.6 mm. wide (on vigorous shoots), broad and rounded at the apex, antical margin arching across the axis, outwardly curved from base to apex, postical margin straight or slightly curved, continuous with the keel or forming a rounded indentation at the junction, margin entire throughout, bordered (except at the base and along the postical side) by from one to three rows of empty hyaline cells; lobule plane throughout or inflated in basal region, narrowly to broadly ovate, about 0.25 mm. long and from 0.12 to 0.17 mm.

* *Lejeunea Goebelii* Gottsche in Goebel, Ann. Jard. Buitenzorg 7: 49. pl. 5, 6. f. 54-59. 1887 (description of gemmae only). *Lejeunea (Colo-Lejeunea) Goebelii* Schiffn. Nova Acta Acad. Caes. Leop.-Carol. 60: 240. pl. 10. f. 1-10. 1893. *Cololejeunea Goebelii* Schiffn. Conspect. Hepat. Archip. Indici 244. 1898.

† *Lejeunea ceatocarpa* Ångstr. Öfversigt Kongl. Vetensk.-Akad. Förhandl. 29: 27. 1872. *Cololejeunea ceatocarpa* Steph. Bull. Herb. Boissier 5: 842. 1897. Evans, Trans. Conn. Acad. 10: 449. pl. 57. f. 7-13. 1900.

wide, apical tooth broad, rounded or retuse at the apex, three to five cells long and three to five cells wide at the base, tipped by two or three cells side by side and bearing a marginal hyaline papilla at their junction, sinus straight or nearly so, free margin more or less involute near base, bearing an acute tooth about midway between base and apex; cells of lobe plane, averaging 16μ along the postical margin, $27 \times 18\mu$ in the middle, and $45 \times 18\mu$ at the base, thin-walled but with minute triangular trigones and occasionally with minute circular intermediate thickenings, hyaline marginal cells thin-walled throughout, a little larger than the adjacent green cells: inflorescence autoicous: ♀ inflorescence sometimes borne on a leading branch, sometimes on a very short branch, innovating on one side, the innovation usually soon floriferous and often repeatedly so; bracts obliquely to widely spreading, the inner one bifid almost to the base, complicate, the lobe as in the leaves but scarcely if at all falcate, 0.75–1 mm. long, 0.45–0.6 mm. wide, lobule ovate, plane, 0.35×0.2 mm. broad and more or less retuse at the apex, margin otherwise entire or vaguely and irregularly sinuate, the proximal marginal tooth rarely apparent; perianth about one third exserted, obovate, 0.75 mm. long, 0.55 mm. wide, broad and retuse at the apex and bearing a short but distinct beak, antical surface plane, postical keel rounded or sometimes two-angled in the upper part, surface smooth or very slightly roughened from projecting cells: ♂ inflorescence occupying a short branch, not proliferating; bracts mostly in from two to four pairs, loosely imbricated, diandrous, without hyaline cells, the lobe rounded and usually revolute at the apex, lobule rotund, rounded at the apex and usually involute along the free margin: capsule 0.25 mm. in diameter; spores (not quite mature) 16μ in short diameter, minutely verruculose. (PLATE II, FIGURES 8–16.)

On leaves of trees. Utuado, *Howe* (862, in part), *E. G. Britton* & *D. W. Marble* (882, in part). No. 882 may be designated the type.

The plant just described is very closely related to *L. marginata*, a species to which reference has already been made. The original *Jungermannia marginata* was described from sterile specimens collected on the island of Mauritius and sent to Lehmann by Presl. A few years later Montagne, under the name *Lejeunea hyalino-marginata* Nees,* listed another plant from Mauritius but gave no diagnosis, so that this name must be regarded as a *nomen nudum*. In the Synopsis Hepaticarum *L. hyalino-marginata* is

* Ann. Sci. Nat. Bot. II. 14: 335. 1840.

quoted under *Lejeunea marginata* as a synonym and the description of the species is amplified so as to include two distinct varieties, one without underleaves and the other with duplicated underleaves. Under the first variety the two Mauritian plants mentioned above are cited; under the second, a single plant from Guadeloupe. The specimen of this second variety in the Lindenberg herbarium consists of two stems, which clearly belong to the genus *Diplasiolejeunea*, so that the true *L. marginata* was known to the authors of the Synopsis from Mauritius only. Later reports of *L. marginata* from the American tropics are also open to suspicion. In addition to the report from Puerto Rico, which has already been disposed of, Gottsche* notes the occurrence of the species in Mexico and Venezuela, and Stephani† cites a specimen from Mexico. The plants quoted by Gottsche are referred by him to his variety *Liebmanniana*, in which the hyaline cells of the leaves are said to be restricted to the apex, so that they are apparently distinct from the true *L. marginata* and also from *L. planifolia* of the present paper. The Mexican specimen which Stephani mentions was collected by Liebmann at Mirador and was referred by Gottsche to *Lejeunea cardiocarpa* Mont. Apparently Stephani has since doubted his determination, because in a recent letter he states that he has seen no *L. marginata* from America, implying at the same time that its discovery here would not be surprising. On the whole, however, in view of the conflicting evidence, it seems wisest to consider that the true *L. marginata* is not yet known on this side of the Atlantic. Even in the Old World its distribution is very inadequately understood. It was reported from Java and Sumatra by Sande Lacoste and from Madagascar by Gottsche, but these seem to be the only new published records.

The writer has been unable to obtain plants of *L. marginata* for study and has again been dependent upon a drawing kindly sent by Stephani. It was made from an African specimen received from Gottsche and presumably of his determination. In this drawing, which shows a portion of the stem with three leaves, the lobule is of the typical *Leptocolea* type. It has a strongly arched

* Mex. Leverm. 228. 1863.

† Hedwigia 29: 91. 1890.

keel and spreads almost at right angles to the axis, instead of obliquely as in *L. planifolia*. The apical tooth, moreover, is short and sharp and the distinct proximal tooth lies about midway between the base and the outer end of the sinus. According to Gottsche the apical tooth consists of two or three cells in a row. On the evidence derived from this drawing and from the published descriptions *L. marginata* is clearly distinct from *L. planifolia*, and the comparison of specimens would probably show still other differences.

In *Leptocolea lanciloba* (Steph.) comb. nov.,* a species known from the Nicobar and Hawaiian Islands, the Puerto Rico plant has another close ally. In *L. lanciloba* the hyaline margin is a little narrower than in *L. planifolia* and the lobule is still more aberrant. It consists of a slender lanceolate or subulate lamina, subparallel with the axis and gradually tapering to the apex. The latter is sometimes tipped with two cells side by side, sometimes by a single cell, and rarely by two superimposed cells. The hyaline papilla appears either at the apex or close to it on the proximal side of the lobule. A little below the middle the proximal tooth, one or two cells long, is situated. These peculiarities will at once distinguish *L. lanciloba* from *L. planifolia* and also from *L. marginata*. Unfortunately, in the Hawaiian material at least, an occasional lobule is found which approaches in its structure the lobule of *L. marginata*. This condition awakens the suspicion that the remarkable lobule just described is inconstant in its characters and that *L. lanciloba* may perhaps be nothing more than an abnormal form of *L. marginata* or of some other species. The question is one, however, which cannot be answered from the material at hand.

Leptocolea cardiocarpa (Mont.)

Lejeunea cardiocarpa Mont. in Ramon de la Sagra, Hist. Fis. Pol. y Natur. Cuba 9: 476. pl. 18. f. 4. 1845.

Lejeunea (*Colo-Lejeunea*) *cardiocarpa* Spruce, Hep. Amaz. et And. 300. 1884.

Pale green, growing scattered or in depressed mats: stems 0.05 mm. in diameter, irregularly branching, the branches widely spreading, similar to the stem: leaves imbricated, the lobe widely

* *Cololejeunea lanciloba* Steph. Hedwigia 34: 250. 1895. Evans, Trans. Conn. Acad. 10: 452. pl. 59. f. 1-7. 1900.

spreading, scarcely or not at all falcate, ovate to oblong, 0.75 mm. long, 0.5 mm. wide, rounded at the apex but tipped with a cluster of more or less divergent hyaline cells, antical margin arching a little beyond the axis, outwardly curved from base to apex, sometimes with a few hyaline but not divergent cells, postical margin straight or nearly so, continuous with the keel or slightly indented at the junction, margin entire (except for the hyaline cells at the apex); lobule inflated throughout the greater part of its extent, ovate, 0.17 mm. long, 0.1 mm. wide, apical tooth consisting of two cells in a row or of a single cell, hyaline papilla borne at base of apical tooth on the inner surface, proximal tooth near the apex, obtuse or rounded, sometimes obsolete, keel slightly arched; cells of lobe plane, averaging 14μ along the margin, $18 \times 16\mu$ in the middle, and $30 \times 16\mu$ at the base, thin-walled but with minute local thickenings (as in *L. planifolia*), hyaline cells thin-walled throughout: inflorescence autoicous: ♀ inflorescence usually borne on a more or less elongated branch, rarely on a very short branch, innovating on one side, the innovation often soon floriferous; bracts similar to the leaves, unequally bifid, complicate, the lobe of about the same size as in the leaves, the lobule about 0.2×0.13 mm., crenulate or denticulate in the upper part; perianth about one third exserted, obovate, 0.55 mm. long, 0.4 mm. wide, truncate or slightly retuse at the apex and with an indistinct beak, antical surface plane or nearly so, postical surface with a broad two-angled keel, surface smooth or slightly roughened from projecting cells: ♂ inflorescence occupying a short branch or terminal on a leading branch, not proliferating; bracts mostly in 5 to 15 pairs, imbricated, diandrous, smaller than the leaves, the lobe obliquely spreading, rounded at the apex, lobule half as long or longer, keel strongly arched, crenulate, free margin with a few crenulations at the apex. (PLATE 12, FIGURES 1-3.)

On bark, more rarely on living leaves. North slope of the Luquillo Mountains, *Heller* (4562). Three miles east of Santurce, *Heller* (464, in part). Seven miles south of Caguas, *Heller* (288, in part). Near Cayey, *Evans* (71, in small part). Widely distributed in tropical America but rarely abundant. The following localities may also be quoted: Cuba, the type station, *Ramon de la Sagra*; Mexico, *Liebmann*; Brazil, *Spruce*. The type specimen in the Montagne herbarium agrees closely with the Puerto Rico material.

The original description and figures of *L. cardiocarpa* by Montagne are so clear and so complete that it has been possible to add only a few unimportant details. At the same time, in spite of its distinctness, the species has been more or less misunderstood by

writers. Gottsche, for example, in his *Mexikanske Levermosser*, cites specimens from various Mexican localities, but according to Stephani several of these are referable to other species. The relationship of *L. cardiocarpa* to *L. planifolia* is close, the two species agreeing in the possession of dry and hyaline cells on the margin of the lobe. In *L. cardiocarpa*, however, these cells are usually restricted to the apex of the lobe, and it is only in rare instances that the apical group is supplemented by a narrow band near the antical base. The hyaline cells at the apex usually form but a single row. They are more or less elongated and spread out in a digitate manner, their outer extremities being free from one another and rounded. The hyaline cells near the base are the same in structure but scarcely project beyond the other marginal cells. Apparently hyaline cells of this character play a part in holding the plants firmly to the substratum, as already noted by the writer in connection with the genus *Stictolejeunea*.* In the structure of the lobule, which conforms closely to the *Leptocolea* type, *L. cardiocarpa* differs markedly from *L. planifolia*. The long antheridial branches are also very distinctive, and the lobes of the perigonal bracts usually bear a cluster of hyaline cells at the apex, just as in the leaves. In *L. planifolia* hyaline cells are never found in this position.

***Leptocolea Jooriana* (Aust.)**

Lejeunea Jooriana Aust. Bull. Torrey Club 6: 20. 1875.

Lejeunea (Colo-Lejeunea) Jooriana Steph. Bot. Gaz. 17: 171. 1892.

Cololejeunea Jooriana Evans, Mem. Torrey Club 8: 173. pl. 22. f. 9-20. 1902.

On living leaves. Near Cayey, *Evans* (71, in small part, mixed with *L. cardiocarpa* and other epiphyllous *Lejeuneae*). The original locality for *L. Jooriana* is in Louisiana, but it is now known also from North Carolina, Florida, the Bahamas, and Bermuda. The type specimen grew on reeds but most of the material examined grew on bark. The occurrence of the species on living leaves in Puerto Rico is not surprising since *L. cardiocarpa*, its nearest ally, also grows on both bark and leaves.

A full description of *L. Jooriana*, with figures, was recently published by the writer, as indicated above. In the present paper,

* Bull. Torrey Club 34: 3. 1907.

therefore, the discussion is restricted to its more important differential characters. The relationship of the species to *L. cardiocarpa* is so very close that the leaves and perianths might be described in almost identical words. The plants differ markedly, however, in their inflorescence, although both are monoicous. In *L. Jooriana* the antheridia are borne, usually singly, in the axils of the perichaetial bracts and occasionally in the axil of the leaf adjacent to the involucre; in *L. cardiocarpa* they are borne, usually in pairs, in the axils of distinct perigonal bracts, which are found on special branches. In consequence of this difference there are further differences in the structure of the perichaetial bracts. In *L. Jooriana* the lobules are inflated much as in ordinary leaves, while in *L. cardiocarpa* the lobules are plane. In well grown plants of *L. Jooriana* the lobules of the leaves are relatively larger than in *L. cardiocarpa*, but this difference is by no means constant. *L. Jooriana* is also characterized by the frequent presence of gemmae, while *L. cardiocarpa* is not yet known to be gemmiparous. Unfortunately this is a difference which it is unsafe to emphasize until the plants are better known. At the present time, therefore, the differences in the inflorescence and in the bracts are the only ones that can be relied upon.

APHANOLEJEUNEA

So far as known at present, about half a dozen species can be referred to *Aphanolejeunea* with certainty. With the exception of the type species, which is known only from the British Isles, the genus is restricted to the tropical and south temperate regions of America. The type species grows on rocks and on bark, often in company with other bryophytes, while most of the American species are epiphyllous in habit. All of them flourish best in very damp localities, on account of their fragile nature.

The stems cling closely to the substratum and branch irregularly. The leaves are usually distant and are never closely imbricated. The lobes spread widely and vary in outline from oblong or ovate to lanceolate, the apex itself varying from rounded to acuminate (PLATE 12, FIGURES 4, 11, and 17). In many cases the lobes are distinctly concave on the antical surface. The lobules, the structure of which has already been described, are

relatively large. As a rule two types of leaves are developed, large and normal leaves with typical lobules and much smaller leaves with rudimentary lobules, and they seem to be unconnected by intermediate types (FIGURES 17 and 18). The leaf cells vary from slightly convex to conical, and none are ever differentiated as ocelli or hyaline cells. Their walls are exceedingly thin and show no trigones, although a strongly conical cell will sometimes show a slight thickening at the apex of the cone. Corresponding with the shape of the cells the margin of the lobe varies from crenulate to denticulate.

A monoicous inflorescence seems to be almost invariably the rule in the genus. Sometimes the male inflorescence is borne on a distinct branch with strongly modified bracts, but it seems to be more usual for the antheridia to be borne in the axils of the leaves below a female inflorescence or even in the axil of one of the perichaetial bracts. Under these circumstances the perigonal bracts are scarcely modified. The female inflorescence always bears one or two subfloral innovations, which may or may not be floriferous. The perichaetial bracts are very much like the leaves, except that the lobules tend to be plane and show differences in the apical region. The perianth is obovoid and inflated, at least near the apex. Sometimes there are no signs of keels; sometimes five keels, more or less marked, can be distinguished. In some cases the beak of the perianth is indistinct or practically obsolete. The sporophyte is essentially like that of *Cololejeunea*. The genus may be characterized as follows:

***Aphanolejeunea* gen. nov.**

Plants very delicate, pale green, often becoming whitish when dry: stems prostrate, sparingly branched: leaves distant to contiguous, the lobe often concave in the outer part, widely spreading, oblong to lanceolate, rounded to acuminate at the apex, the margin usually crenulate or denticulate from projecting cells; lobule inflated, the involute free margin often including the apex, sinus lunulate, apical tooth consisting of a single projecting cell, separated by a slight indentation from the usually less distinct proximal tooth, hyaline papilla distal to the apex, situated in the sinus but slightly displaced to the inner surface, keel arched; cells of lobe uniform, convex to conical, usually thin-walled throughout: underleaves wanting: inflorescence mostly autoicous

or paroicous: ♀ inflorescence borne on a leading branch with one or two innovations; bracts complicate, unequally bifid, the lobe as in the leaves, the lobule plane; perianth obovoid, terete or five-keeled in the upper part, rounded at the apex and abruptly contracted at the apex into a short (sometimes obsolete) beak, surface often roughened from projecting cells. (Name from *ἀφανής*, invisible, and *Lejeunea*, in allusion to the inconspicuous character of the species.)

Type species, *Aphanolejeunea microscopica* (Tayl.) comb. nov. *Jungermannia microscopica* Tayl. in Mackay, Fl. Hibern. 2: 59. 1836. *Lejeunea microscopica* Tayl. in G. L. & N. Syn. Hep. 345. 1845. *Lejeunea* (*Colo-Lejeunea*) *microscopica* Spruce, Hep. Amaz. et And. 293. 1884. *Cololejeunea microscopica* Schiffn. in Engler & Prantl, Nat. Pflanzenfam. 1³: 122. 1895.

Three species that are apparently referable to *Aphanolejeunea* have been reported from Puerto Rico, namely: *Lejeunea sicaefolia* Gottsche, *L. Sintenisii* Steph., and *L. heterophylla* Goebel. The first two are cited by Stephani,* the third by Goebel.† Unfortunately *L. Sintenisii* and *L. heterophylla* are known to the writer from descriptions and figures only, and it seems necessary at the present time to withhold judgment in regard to them. *L. sicaefolia*, however, has been collected in some quantity, and two other species, apparently undescribed, are also present in the material examined.

Aphanolejeunea exigua sp. nov.

Pale green, scattered or growing in thin mats, often mixed with other hepatics: stems zigzag, 0.025 mm. in diameter, usually simple except for the subfloral innovations: leaves distant, obliquely spreading, subsquarrose, the lobe ovate, concave, 0.2 mm. long, 0.1 mm. wide, apex mostly subacute and tipped with a single cell, rarely blunt and tipped with two cells side by side, antical margin spreading widely from the very base, slightly curved, postical margin beyond the keel very short, straight or slightly curved, margin crenulate from projecting cells; lobule ovate, 0.15 mm. long, 0.1 mm. wide, inflated throughout but more strongly so in the basal portion, free margin involute to beyond the apex, the latter tipped with a more or less curved cell or apical tooth, proximal tooth slightly projecting, also consisting of a single cell,

* Hedwigia 27: 290, 291. pl. 12. f. 21-24. pl. 13. f. 27. 1888.

† Pflanzenbiol. Schild. 1: 178, 179. f. 79. 1889.

sinus lunulate, about three cells long, hyaline papilla in the sinus but displaced one cell from the margin, keel arched near base, roughened from conical cells; cells of lobe averaging about $18 \times 14\mu$ in the middle, plane to strongly convex or conical, usually thin-walled throughout: inflorescence paroicous: ♀ inflorescence borne on a simple stem (in all observed instances), innovating on one or both sides, the innovations simple and sterile; bracts obliquely spreading, sometimes scarcely complicate, subequally bifid, the lobe ovate, 0.15 mm. long, 0.06 mm. wide, apex and margin as in the leaves, lobule ovate-lanceolate, 0.15 mm. long, 0.05 mm. wide, acute and usually bearing a second sharp tooth on the inner margin near the apex, otherwise entire; perianth obovoid, 0.3 mm. long, 0.25 mm. wide, terete in upper portion, rounded above and bearing a short and broad, sometimes obsolete, beak, surface smooth below, rough in upper half from conical cells: ♂ bracts in a single pair below the involucre, monandrous, otherwise like the normal leaves: capsule about 0.1 mm. in diameter; spores 9μ in short diameter; elaters 5μ wide. (PLATE 12, FIGURES 4-10.)

On living leaves. El Yunque, *Evans* (21, in part, mixed with *Cyclolejeunea accedens* and *Drepanolejeunea infundibulata*).

The present species shows the contrast between normal and rudimentary leaves in a very marked way. In a normal leaf the lobule is relatively large and the lobe projects beyond the water sac for only about one fourth its length. The projecting portion is rarely more than three or four cells long and four or five cells broad; it is usually distinctly concave, the margin on each side being curved upward. All the cells in the projecting portion are strongly convex, thus giving the effect of marginal crenulations; in the vicinity of the keel the cells tend to become conical and occasionally show a slight thickening of the wall at the apex of the cone. The free margin of the lobule is appressed to the lobe as far as the apical tooth, which projects slightly beyond the proximal tooth at its base. The rudimentary leaves (not shown on the plate) are scattered about among the normal leaves, and many of the plants fail to show them altogether. The lobes in such leaves are narrow and lanceolate, perhaps four or five cells long and three or four cells broad, and the lobules are often represented by a single cell. Aside from the subfloral innovations branching seems to be exceedingly rare, and there seems to be no

connection between the branches and the rudimentary leaves as in certain other members of the genus.

One of the closest relatives of *A. exigua* is the rare type species, *A. microscopica*, specimens of which have been received from Macvicar. The two species equal each other in delicacy and are of about the same size. The lobes of the leaves are also very much alike and the lobules are almost identical in structure. The two species agree further in their paroicous inflorescence. In *A. microscopica*, however, the cells of the lobes are less strongly convex and the margin consequently is either entire or very vaguely crenulate; along the keel the roughness is better marked although less conspicuous than in *A. exigua*. There are also slight differences in the bracts. In *A. microscopica* the lobes average about 0.25×0.09 mm. and the cells near the apex are often distinctly conical instead of merely convex as in *A. exigua*. Sometimes one of the bracts in the British species bears an antheridium in its axil, and the lobe of such a bract is usually less roughened than an ordinary perichaetial bract. The lobule measures about 0.18×0.07 mm. and shows two teeth much as in *A. exigua*. The perianths, so far as can be judged from Pearson's description, are very much alike. The differences in the gemmae will be considered later.

Goebel's *Lejeunea heterophylla* has never been formally published, but in his Pflanzenbiologische Schilderungen he alludes to some of its most striking peculiarities and shows them in a figure. The specimen he studied grew on the leaves of *Vittaria remota* in Puerto Rico, but nothing more definite about the locality is stated. According to his account the species is allied to *A. exigua*; it is said, however, to produce leaves with lobules and rudimentary leaves practically destitute of lobules in definite succession and to have a five-keeled perianth. In a letter from Goebel he states that he has preserved no specimens of *L. heterophylla* and would prefer to have the species considered as inadequately published. In any case the five-keeled perianth would serve to distinguish it from *A. exigua*.

In *Lejeunea Sintenisii*, which is known only from the type material collected by Sintenis (136), the plants are said to be much branched and to be dioicous. According to Stephani's figure the leaves are similar to those of *A. exigua* except that the lobe projects

for about half its length beyond the lobule and is built up of many more cells, the projecting portion being about eight cells long and six cells wide. The perichaetial bracts, also, are smaller and their lobules are greatly reduced. Neither perianths nor male inflorescences are present in the specimens. It is to be hoped that this species may be again collected so that its characteristics and relationships may become better known.

***Aphanolejeunea crenata* sp. nov.**

Pale green, growing in small mats among other *Lejeuneae*: stems straight or nearly so, 0.025 mm. in diameter, sparingly and irregularly branched, the branches widely spreading: leaves distant to contiguous, the lobe obliquely spreading, oblong, plane or slightly concave, 0.25 mm. long, 0.07 mm. wide, not falcate, apex obtuse or subacute, tipped with a single rounded cell, antical margin spreading from the base, slightly curved, postical margin beyond the keel straight to slightly curved, margin crenulate from projecting cells; lobule ovate, 0.12 mm. long, 0.07 mm. wide, inflated throughout, free margin involute to apex, apical tooth blunt and slightly curved, proximal tooth rounded, indistinct, each tooth consisting of a single cell, sinus lunulate, about three cells long, hyaline papilla in sinus but displaced one cell from the margin, keel arched, roughened from projecting cells; cells of lobe averaging about $23 \times 16\mu$ near the base, and about 16μ in other parts, more or less convex, thin-walled throughout: inflorescence paroicous (or synoicous): ♀ inflorescence borne on a more or less elongated branch, innovating on one side, the innovation (so far as observed) simple and sterile; bracts erect-spreading to obliquely spreading, complicate, unequally bifid, the lobe as in the leaves, lobule ligulate, about 0.15 mm. long and 0.06 mm. wide, blunt at the apex, margin crenulate in upper part from projecting cells; perianth obovate, 0.35 mm. long, 0.18 mm. wide, inflated above and with faint indications of five keels, each keel being represented by a small group of projecting cells, subtruncate at the apex and with a short beak, surface (except for the rudimentary keels) usually smooth, rarely slightly roughened from scattered projecting cells: antheridia borne singly, usually one in the axil of the leaf below a subfloral innovation and another in the axil of the opposite perichaetial bract; leaves bearing the antheridia much like ordinary leaves: capsule (not quite mature) 0.08 mm. in diameter; elaters from an old capsule 5μ wide. (PLATE 12, FIGURES 11-16.)

On living leaves. El Yunque, *Evans* (36, in small part, in company with *Drepanolejeunea Araucariae*, etc.).

The rudimentary leaves in *A. crenata* seem to be confined to the bases of vegetative branches and are not found in a similar position on innovations. They are often only four or five cells long by three or four cells wide and show practically no lobules. Usually only one or two leaves at the base of a branch will show this rudimentary structure. The species rivals *A. exigua* in fragility and agrees with it in possessing a paroicous inflorescence, the only difference being that in *A. crenata* one of the antheridia is commonly borne in the axil of a perichaetial bract. When compared further with *A. exigua* the lobes of the leaves are found to be plane or nearly so, to have their margins practically parallel, and to project for about half their length beyond the lobules. *A. crenata* differs also in the structure of the perianth, which is not only narrower than in *A. exigua* but is smoother in the upper part, the roughness being often confined to the indistinct keels. The fact that only one subfloral innovation is produced should also be emphasized. Unfortunately the species was collected in very small quantity.

***Aphanolejeunea sicaefolia* (Gottsche)**

Lejeunea sicaefolia Gottsche, Abh. Bremen Naturw. Ver. 7: 362. 1882 (*nomen nudum*).

Lejeunea (Cololejeunea) sicaefolia Gottsche in Stephani, Hedwigia 27: 290. pl. 12. f. 21-24. 1888.

Pale green, scattered among other hepatics or growing in loose depressed mats: stems not zigzag, 0.025 mm. in diameter, sparingly and irregularly pinnate, the branches widely spreading, similar to the stem: leaves distant, obliquely to widely spreading, the lobe lanceolate, slightly falcate, 0.4 mm. long, 0.1 mm. wide, somewhat concave and often variously curved and contorted in outer part, apex acuminate, usually tipped with a row of two or three cells, antical margin spreading from the base, slightly curved, postical margin beyond the keel straight or nearly so, margin (except at the very base) denticulate or crenulate from projecting cells; lobule ovate, 0.17 mm. long, 0.1 mm. wide, similar to that of *A. exigua*; cells of lobe averaging 14μ at the margin and $30 \times 14\mu$ in median and basal regions, conical, thin-walled throughout or with a slight thickening at the apex of the cone: inflorescence autoicous: ♀ inflorescence borne on a more or less abbreviated branch, innovating on one side, more rarely on both, the innova-

tions sterile or soon again floriferous; bracts obliquely spreading, more or less complicate, the lobe as in the leaves but usually a little smaller, measuring about 0.35×0.07 mm., lobule ovate, 0.17 mm. long, 0.03 mm. wide, bidentate at the apex, otherwise subentire; perianth obovoid, 0.4 mm. long, 0.2 mm. wide, rounded at the apex and bearing a short beak, inflated and five-keeled in the upper part, the keels sharply denticulate from high-conical cells, surface between the keels sometimes smooth but usually more or less roughened like the keels: ♂ inflorescence occupying a short branch or terminal on a longer branch, rarely proliferating; bracts contiguous but scarcely imbricated, the lobe as in the leaves but shorter and narrower, lobule reduced to a small basal fold; antheridia borne singly: capsule about 0.1 mm. in diameter; spores 9μ in short diameter; elaters 5μ wide. (PLATE 12, FIGURES 17-26.)

On leaves and logs. Without definite locality, *Sintenis* (4). North slope of the Luquillo Mountains, *Heller* (4647, in part). El Yunque, *Evans* (13). The species is also known from Cuba, *Wright*, *Underwood*, and from Trinidad, *Crueger*. Although Gottsche first applied the name *Lejeunea sicaefolia* to the plant from Trinidad, the specimen collected by Sintenis should be regarded as the type of the species, because it was from this that the first published description was drawn. The determination of the specimens described above was confirmed by Stephani.

Rudimentary leaves are very frequent in *A. sicaefolia*. The leaves subtended by branches seem to be invariably of this type, and the same is true of the leaves at the base of a vegetative branch. These statements, however, do not apply to perichaetial bracts and subfloral innovations. In many cases, also, rudimentary leaves are scattered irregularly among normal leaves and show no connection with branches. In a well developed leaf the lobe is more than three times the length of the lobule. In the basal part, where it helps to form the water sac, it is plane or nearly so, but the free apical portion is usually irregularly curved or twisted and also distinctly concave, the antical margin being curved in such a way that the marginal denticulations extend upward instead of outward. In typical cases the interior cells of the free portion resemble the marginal cells in being conical and often show a slight thickening of the wall at the apex of the cone, but these conical cells may be few or absent altogether and are

never found in the portion of the lobe which covers over the water sac. The lobule is inflated throughout its entire extent and the free margin lies in contact with the lobe as far as the proximal tooth. This is usually a little more prominent than the apical tooth, which rarely shows clearly without flattening out the lobule. In the rudimentary leaves the lobe is shorter and narrower than in normal leaves and is sometimes reduced to a width of only two or three cells. The lobule in such leaves is merely a minute basal fold, sometimes consisting of a single cell. The perigonal bracts are also much more rudimentary in structure than in normal leaves and in extreme cases may be even shorter than the leaves just described. These bracts can afford but little protection to the antheridia, which at maturity often exceed their lobes in width. According to Stephani the perianth of *A. sicaefolia* is destitute of keels but the perianths he studied, according to his figure, were very immature. In mature perianths the five keels are sometimes apparent, but are often difficult to demonstrate when the faces between them are roughened in the same way.

The lanceolate acuminate lobes and the autoicous inflorescence, together with the small perigonal bracts, will at once serve to distinguish *A. sicaefolia* from the two preceding species. A closer relative is apparently the Brazilian *Lejeunea* (*Colo-Lejeunea*) *liliputiana* Spruce,* known to the writer from description only. This species, which is also autoicous, is even smaller than *A. sicaefolia*, the leaves being only 0.15 mm. long. It is characterized further by the obtuse lobes of its leaves and by its smooth perianth.

THE GEMMAE OF COLOLEJEUNEA, LEPTOCOLEA, AND APHANOLEJEUNEA

The remarkable discoid gemmae found in the genus *Cyclolejeunea* were described by the writer several years ago.† Each one arises from a marginal cell of a leaf lobe, and the stalk cell from which it becomes separated at maturity is attached to its basal edge. The three genera treated in the present paper also develop discoid gemmae, but these differ primarily from the gemmae of *Cyclolejeunea* in being borne on the surface of the leaf lobes instead

* Hep. Amaz. et And. 297. 1884.

† Bull. Torrey Club 31: 205-210. pl. 9, 10. 1904.

of on the margin. In consequence of this position the stalk cell becomes displaced, as it were, from the margin to the surface of the gemma but is always eccentrically attached. Since the gemmae in *Cololejeunea* are essentially like those in *Leptocolea* and *Aphanolejeunea*, the three genera will be considered together. In some species gemmae are very abundantly produced, while in others they are much more sparingly developed. It is probable in fact that certain species are never gemmiparous, but it would be premature to make a statement to this effect about many individual species at the present time. The production of gemmae is not accompanied by any striking modifications in leaf structure or by any marked limitation of growth.

The structure and development of the gemmae have been described more or less fully by Goebel in *Leptocolea Goebelii*,* by Stephani in *Leptocolea cuneifolia* (Steph.) comb. nov.,† by Cavers in *Cololejeunea calcarea*,‡ and by Stevens in *C. Biddlecomiae*.§ Stevens showed that the gemmae of *C. Biddlecomiae* and *C. calcarea* pursued essentially the same course of development as that described by Goebel for the gemmae of *L. Goebelii* and explained the slight discrepancies to be found in Cavers's account of *C. calcarea*. The writer has been able to study the gemmae in five species of *Cololejeunea*, nine of *Leptocolea*, and two of *Aphanolejeunea* and finds that all agree closely in their development with the species discussed by Stevens. According to his account the leaf cell which is to form a gemma projects beyond its neighbors and divides by a wall parallel with the surface of the leaf. The outer cell represents the mother cell of the gemma, while the inner cell becomes the stalk. The mother cell then proceeds to divide by a series of walls perpendicular to the leaf surface, and the resulting gemma consists in consequence of a plate of cells one cell thick. The first wall divides the mother cell into two semicircular cells, and the subsequent divisions which take place in these cells are the same, thus making the mature gemma symmetrical with respect to the median plane. The two semicircular cells are first divided

* Ann. Jard. Buitenzorg 7: 240. 1887.

† = *Lejeunea* (*Cololejeunea*) *cuneifolia* Steph. Hedwigia 30: 167. pl. 10. 1892.

‡ New Phytol. 2: 160. f. 8. 1903.

§ Bull. Torrey Club 37: 366-369. f. 1. 1910.

into approximately equal quadrants. Then, as Stevens goes on to show, the two apical quadrants grow more rapidly than the two basal quadrants, thus forcing the wall between them into an oblique position with respect to the median walls. The two apical quadrants function as apical cells, the first segment in each being cut off by a wall parallel to the median wall. The segments undergo further divisions, the first walls being always periclinal. The basal quadrants also become subdivided in much the same way as the oldest segments. The eccentrically situated stalk cell is approximated more or less to the basal margin (TEXT FIGURE 2, C, D), and the gemma becomes free by a splitting of the walls by which it is attached to the stalk cell.

When the gemmae of various species are compared it is found that they differ in size and in the number of cells of which they are composed, but that, for a given species, the number of cells is fairly constant. The differences in the number of cells are due primarily to the number of segments cut off by the apical quadrants and secondarily to the number of subsequent divisions which take place in the segments and in the basal quadrants. In the simplest gemmae only two segments are cut off, each of which divides once, while each of the basal quadrants divides into three cells, the first division being by the usual periclinal wall and the second by an anticlinal wall in the outer cell. These divisions give rise to a gemma composed of sixteen cells, a condition seen clearly in *Aphanolejeunea microscopica*, *A. exigua*, *Cololejeunea myriocarpa*, and *C. Macounii* (Spruce) Evans;* occasionally, in *C. myriocarpa* at least, one or both of the younger segments fail to divide, so that the mature gemma consists of only fourteen or fifteen cells. It will be seen that gemmae of this type tend to be symmetrical with respect to a transverse median plane as well as a longitudinal plane (TEXT FIGURE 1, A-C; PLATE 12, FIGURE 10).

The cutting off of three segments takes place in the gemmae of *Cololejeunea calcarea*, *C. Biddlecomiae*, ***Leptocolea ovalifolia*** (Evans) comb. nov.,† and *L. cuneifolia* (TEXT FIGURE 1, D, E).

* Mem. Torrey Club 8: 171. pl. 22. f. 1-8. 1902. *Lejeunea* (*Cololejeunea*) *Macounii* Spruce in Underwood, Bull. Torrey Club 17: 259. 1890. The species is probably a *Leptocolea*, judging from its vegetative structure; unfortunately mature perianths have not been seen by the writer. It is known from British Columbia only.

† = *Cololejeunea ovalifolia* Evans, Trans. Conn. Acad. 10: 450. pl. 58. f. 1-6. 1900. Known from the Hawaiian Islands only.

This is usually accompanied by a more vigorous cell division and gives rise to gemmae composed of from twenty to twenty-four cells. In the gemmae of *Cololejeunea diaphana* there are also only three segments cut off as a rule, the number of cells at maturity being twenty. In one instance, however, a gemma was observed in which one of the apical quadrants had cut off four segments and in which the total number of cells was twenty-two (TEXT FIGURE 1,

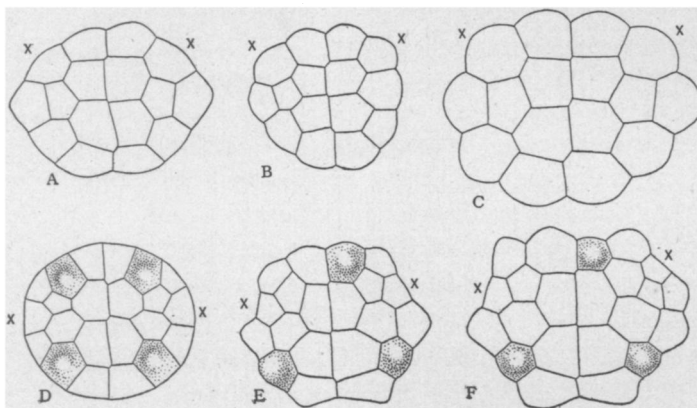


FIGURE 1. Gemmae, $\times 300$. The apical cells are indicated in the usual way. A. *Aphanolejeunea microscopica*; Argyllshire, Scotland, *Macvicar*. B. *Cololejeunea myriocarpa*; near Cayey, Puerto Rico, *Evans* (101). C. *C. Macounii*; British Columbia, *Macoun* (Hep. Amer. 177). D. *Leptocolea ovalifolia*; Oahu, Hawaiian Islands, *Cooke*. E. *L. cuneifolia*; Kamerun, *Dusén* (Hep. Afr. 501). F. *Cololejeunea diaphana*; near Santurce, Puerto Rico, *Heller* (464).

F). In the gemmae of *Cololejeunea minutissima*, *Leptocolea Jooriana*, and *L. scabriflora* four segments are cut off (TEXT FIGURE 2, A, B; PLATE II, FIGURE 8). In *C. minutissima* the subsequent divisions are very numerous and gemmae with as many as thirty-four cells are sometimes found. In the other two species the number of cells seems to be pretty constantly twenty-four. The most complicated gemmae, in which five segments are cut off, are found in four species of *Leptocolea*, namely: *L. lanciloba*, *L. longistylis* (Evans) comb. nov.,* *L. ceatocarpa*, and *L. Goebelii* (TEXT FIGURE 2, C, D; 3, A, D). In the first two, where the cell division is especially active, the mature gemmae are composed of forty

* = *Cololejeunea longistylis* Evans, Trans. Conn. Acad. 10: 453. pl. 59. f. 8-16. 1900. Known from the Hawaiian Islands only.

or more cells; in *L. ceatocarpa* the number of cells is usually thirty-eight, while in *L. Goebelii* it is only thirty,—fewer than in *C. minutissima*, in which only four segments are cut off.

Aside from the differences in the number of segments and in the number of cells present at maturity, the gemmae of different species are characterized by peculiarities of the marginal cells, by the presence or absence of "Haftorgane," or organs of attachment, and by the number and situation of these organs. With regard to the margin there are certain species in which none of the marginal

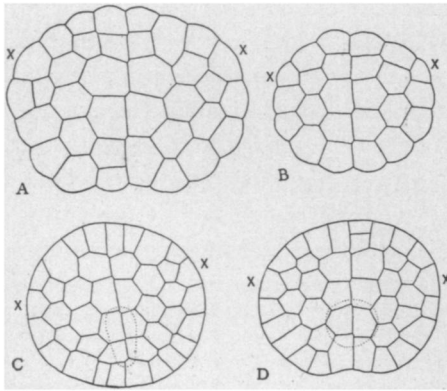


FIG. 2.

FIGURE 2. Gemmae, $\times 300$. A. *Cololejeunea minutissima*; Florence, Italy, Levier. B. *Leptocolea Jooriana*; Lisbon, Florida, Underwood (95). C. *L. lanciloba*; Oahu, Hawaiian Islands, Cooke. D. *L. longistylis*; Oahu, Hawaiian Islands, Cooke.

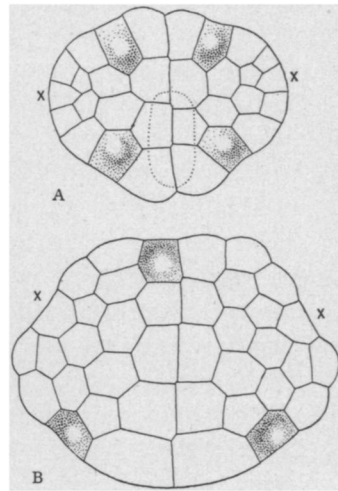


FIG. 3.

FIGURE 3. Gemmae, $\times 300$. A. *Leptocolea Goebelii*; Tjibodas, Java, Fleischer. B. *L. ceatocarpa*; Hawaiian Islands, Heller (2562).

cells project. This is true, for example, of *L. lanciloba*, *L. longistylis*, and *L. ovalifolia*, and the margin in these may be described as perfectly entire. It is much more usual, however, for some or all of the cells to project in the form of crenulations or denticulations, according to whether they are convex or conical. In gemmae with convex cells, the margin is sometimes crenulate throughout as in *Cololejeunea myriocarpa*, *C. minutissima*, *C. Macounii*, and *Leptocolea Jooriana*. In *L. ceatocarpa*, however, only the marginal

cells of the younger segments project, while in *L. Goebelii* the cells bounding the median wall are the only ones affected. In gemmae with marginal denticulations it is always certain special cells that project and these are always definite in position. The outer cell of the youngest segment is the one most certain to show this condition, as in *Aphanolejeunea microscopica*, but it is not usual for this cell to be the only one that projects. In *A. exigua*, for example, the two basal cells and the opposite one on one side also project, and this statement will apply equally well to *Cololejeunea diaphana* and *Leptocolea cuneifolia*, where more segments are cut off.

The remarkable organs of attachment are fully described by Goebel in the case of *Leptocolea Goebelii*. They represent marginal cells which project at right angles to the two surfaces of a gemma. At their extremities they secrete a slime which enables the gemma to attach itself to the substratum. These organs of attachment are not found in all species and are most frequent in the epiphyllous species of the tropics. Of the sixteen species studied by the writer seven develop such organs, while the others lack them completely. When present they are not only constant in number for a given species but also constant in position. In *Leptocolea Goebelii* and *L. ovalifolia* four organs of attachment are developed; in *L. ceatocarpa*, *L. scabrifolia*, *L. cuneifolia*, *Cololejeunea diaphana*, and *Aphanolejeunea exigua* there are only three. When four are present two are developed from the basal quadrants and two from the first segments cut off from the apical quadrants. In each of these a periclinal wall is first formed in the usual way and then the outer cell divides again by an anticlinal wall. Of the two marginal cells thus formed the one farther from the median wall becomes modified into the organ of attachment. When only three organs are present two are developed from the basal quadrants, which divide in the way just described.* The third is formed from the first segment on one side. This divides by the usual periclinal wall and then the outer of the two cells thus formed becomes modified into the organ of attachment without undergoing a preliminary anticlinal division. For this reason the organ is situated

* In *L. ceatocarpa* the division goes one step farther, the cells which would naturally be expected to develop into organs of attachment first dividing by periclinal walls.

next the median wall. The corresponding segment on the other side of the gemma divides in the same way but the outer cell does not become modified. It will be seen at once that when three organs of attachment are present the gemma shows a condition of slight asymmetry, in spite of the fact that the cells on each side of the median wall are alike in number and position. When four organs are present the condition of symmetry is maintained.

Although the gemmae in the *Lejeuneae* have been but little studied by taxonomists it will be seen from the above account that they present characters of great constancy. They can often, in fact, be used in the determination of specimens which are sterile or otherwise imperfectly developed. This is true, for example, of the closely related *Cololejeunea minutissima* and *C. myriocarpa*, where the lobules are usually either rudimentary or abnormally developed. To summarize what is known about the Puerto Rico species it may be stated that only five of the species described in this paper have been proved to be gemmiparous. In the gemmae of two of these, *Cololejeunea myriocarpa* and *Leptocolea Jooriana*, no organs of attachment are present and the margin is crenulate throughout; in the other species, *C. diaphana*, *L. scabriflora*, and *Aphanolejeunea exigua*, the gemmae develop three such organs and only certain of the marginal cells project. With regard to the number of segments cut off by the apical quadrants, *A. exigua* and *C. myriocarpa* have only two, *C. diaphana* almost invariably has three, while *L. scabriflora* and *L. Jooriana* have four.

The germination of the gemmae was studied by Goebel in the case of *L. Goebelii*. He found that the apical cells first cut off a series of segments but that very soon one of them gave rise to the leafy shoot, and he considered that the tetrahedral apical cell of the stem was cut out directly from the two-sided apical cell of the gemma. Occasionally he saw the leafy plant arise from one of the cells next the median wall between the two basal organs of attachment. The writer has been able to confirm these observations but can add very little to them. It may perhaps be of interest to note, however, that in gemmae with three organs of attachment the leafy shoot usually arises from the apical cell on the side with two such organs.

Explanation of plates 11 and 12

As in the previous papers of this series the figures were drawn by the writer, and most of them were prepared for publication by Miss Edna L. Hyatt.

PLATE 11

Leptocolea scabri flora (Gottsche) Evans. 1. Part of stem with two fertile branches and a male inflorescence, postical view, $\times 35$. 2. Apex of branch with antheridia, postical view, $\times 35$. 3. Apex of a typical perigonial spike, postical view, $\times 35$. 4. Cells from margin of lobe near apex, $\times 265$. 5. Part of lobule, showing apical and proximal teeth, $\times 200$. 6. Perichaetial bract, $\times 45$. 7. Transverse section of perianth near apex, $\times 45$. 8. Gemma, $\times 265$. The figures were all drawn from specimens collected by the writer (72, in part).

Leptocolea planifolia Evans. 9. Part of plant with four female inflorescences (including two perianths), postical view, $\times 25$. 10. Part of plant with a male and a female inflorescence, postical view, $\times 35$. 11. Cells from middle of lobe, $\times 265$. 12. Cells from apex of lobe, $\times 200$. 13. Apical part of lobule, $\times 200$. 14, 15. Perichaetial bracts, $\times 35$. 16. Transverse section of perianth, $\times 45$. The figures were all drawn from specimens collected by M. A. Howe (862, in part).

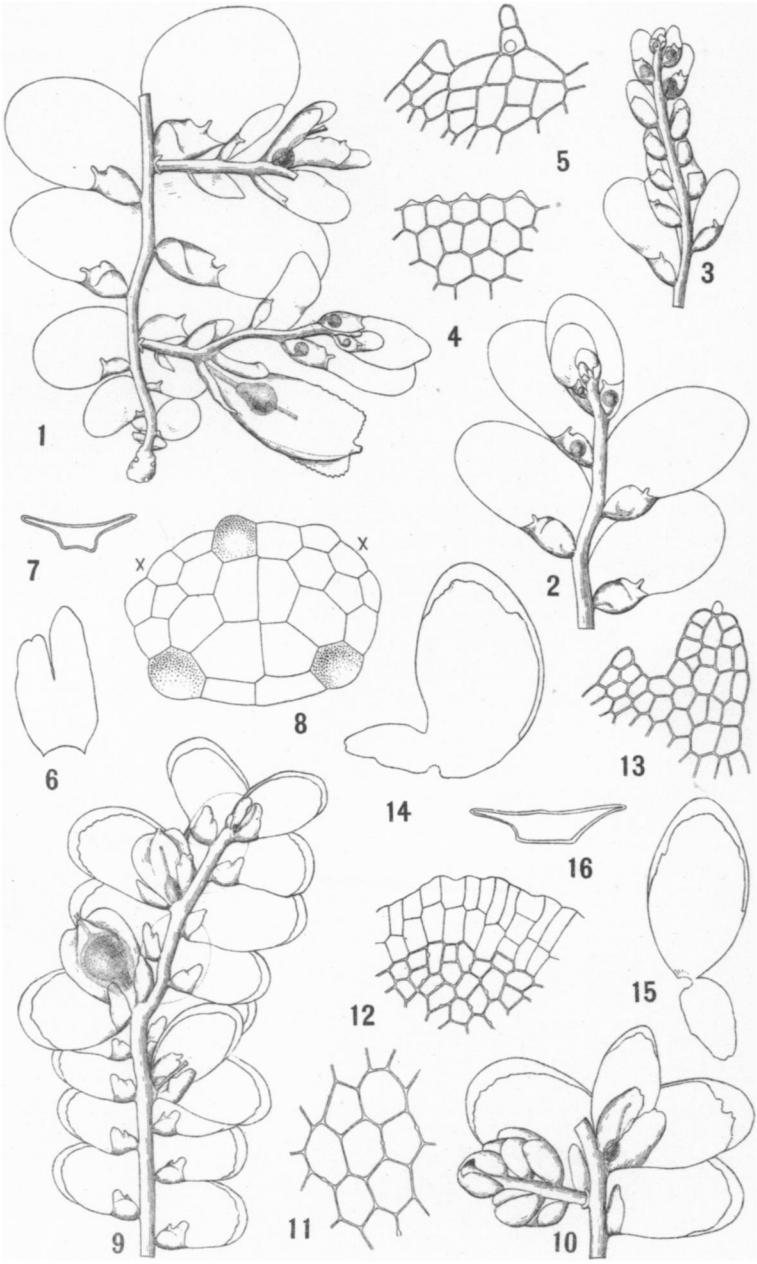
PLATE 12

Leptocolea cardiocarpa (Mont.) Evans. 1. Part of plant with three perianths and an old capsule, postical view, $\times 35$. 2. Part of plant with male inflorescence, postical view, $\times 35$. 3. Apical part of lobule, $\times 200$. The figures were all drawn from specimens collected by A. A. Heller (288, in part).

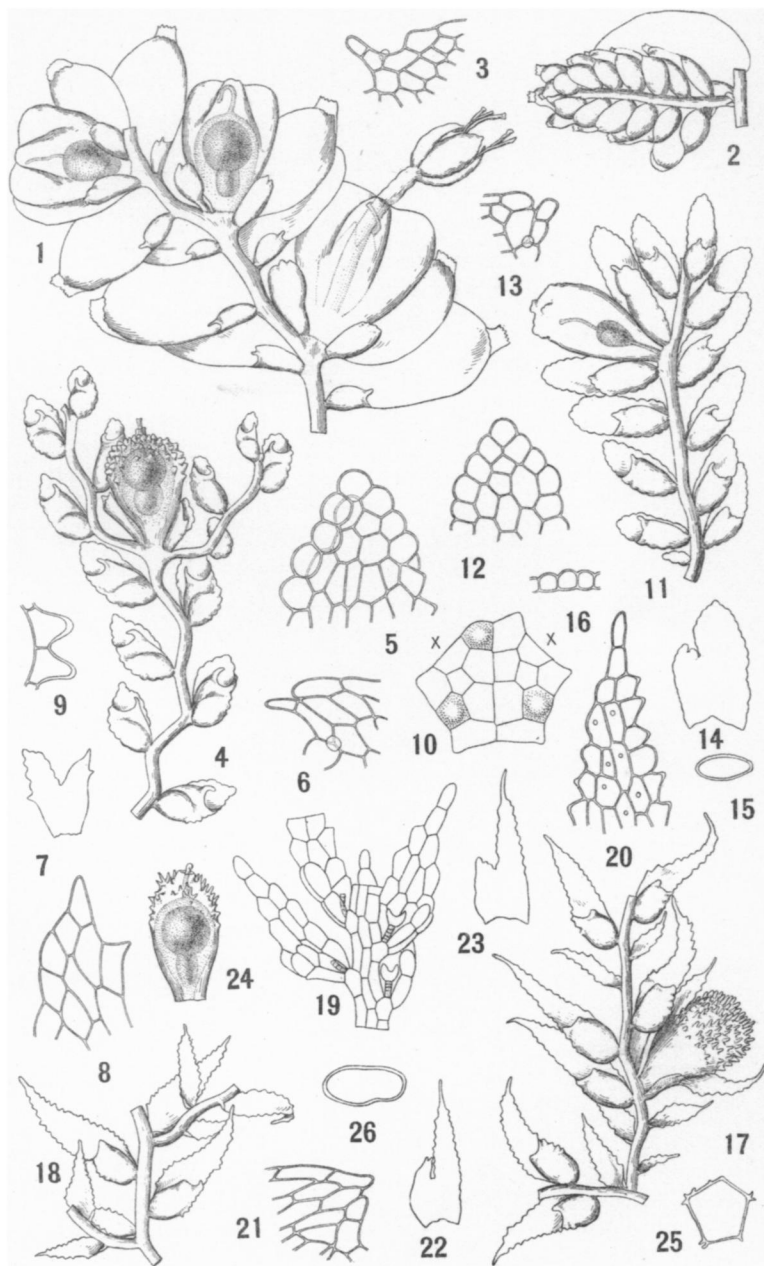
Aphanolejeunea exigua Evans. 4. Apex of plant with perianth, postical view, $\times 55$. 5. Apex of lobe, $\times 200$. 6. Apex of lobule, $\times 200$. 7. Perichaetial bract, $\times 55$. 8. Apex of lobule of bract, $\times 200$. 9. Cells from apical part of perianth in optical section, $\times 200$. 10. Gemma, $\times 265$. The figures were all drawn from the type specimen.

Aphanolejeunea crenata Evans. 11. Part of plant with perianth, postical view, $\times 55$. 12. Apex of lobe, $\times 200$. 13. Apex of lobule, $\times 200$. 14. Perichaetial bract, $\times 55$. 15. Transverse section of perianth in lower part, $\times 55$. 16. Cells of perianth in section, $\times 200$. The figures were all drawn from the type specimen.

Aphanolejeunea sicaefolia (Gottsche) Evans. 17. Part of plant with perianth, postical view, $\times 55$. 18. Part of stem with two branches, postical view, $\times 55$. 19. Part of a male inflorescence, postical view, $\times 200$. 20. Apex of lobe, $\times 200$. 21. Apex of lobule, $\times 200$. 22, 23. Perichaetial bracts, $\times 45$. 24. Perianth, antical view, $\times 55$. 25. Transverse section of perianth in apical portion, $\times 55$. 26. Transverse section of perianth nearer the base, $\times 55$. The figures were all drawn from specimens collected by the writer (13).



1—8 LEPTOCOLEA SCABRIFLORA (Gottsche) Evans
9—16 LEPTOCOLEA PLANIFOLIA Evans



1-3 *LEPTOCOLEA CARDIOCARPA* (Mont.) Evans

4-10 *APHANOLEJEUNEA EXIGUA* Evans

11-16 *APHANOLEJEUNEA CRENATA* Evans

18-26 *APHANOLEJEUNEA SICAEOFOLIA* (Gottsche) Evans